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Application of Neutrosophic Multi-Criteria Decision-Making Techniques for Assessing Violations of Child Support Rights

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Abstract. The study addresses a crucial challenge in the analysis of rights violations by applying neutrosophic methods. Specifically, it investigates how multi-criteria assessment tools can provide a more precise and nuanced approach to addressing rights violations, a topic that remains of global relevance, given the complexity and diversity of situations that occur in different contexts. The existing literature, although abundant in human rights studies, often lacks approaches that integrate the uncertainty and ambiguity inherent in these cases, limiting the effectiveness of conventional analyses. This work fills that gap by implementing a neutrosophic approach that captures these dynamics more effectively and adequately. Using the neutrosophic-based multi-criteria assessment methodology, the study employs advanced techniques to manage and model the indeterminacy present in human rights violations. The analysis undertaken reveals that this approach allows for a more complete and robust assessment of the circumstances of rights violations, by integrating the divergent perceptions of the experts and actors involved. The findings underline how this approach improves decision-making in scenarios where situations are not entirely clear or definitive. The study's contribution lies in offering a more precise and practically applicable methodology for human rights assessment, allowing for a more nuanced and reliable analysis that can influence policies and corrective actions at a global level.

Keywords: Multicriteria Evaluation, Neutrosophy, Uncertainty, Ambiguity, Advanced Analysis, Decision Making, Divergent Perception, Corrective Policies, Robust Analysis, Human Rights, Neutrosophical Approach.

1. Introduction

Child support is recognized as a fundamental right throughout the world and strict disciplinary sanctions have always been applied to those who fail to meet their obligations. Various sanctions are used to ensure that these rights are not violated, and in Latin America similar sanctions are applied to those who have child support obligations as part of their efforts to protect the best interests of the child. In the case of Ecuador, it was stated that both child support payers and pension administrators have rights and obligations. However, there have been cases of misappropriation of funds by the administration, which constitutes a violation of this right [10].

A judgment is a final decision issued by a judge or court to resolve a legal dispute and conclude a case. It is an order intended to end a dispute and represents a final decision to resolve a dispute between two parties [11]. Alimony is defined as an amount paid periodically to cover the living expenses of the beneficiary. These funds are supposed to be used only for the support of the beneficiaries, but the lack of transparency in their management causes serious problems.

The problem is the lack of an efficient system that ensures that costs are only passed on to the beneficiaries. This creates uncertainty as to whether the funds are used to meet the needs of the beneficiaries, such as food, clothing, housing, healthcare and education [12]. This situation is further facilitated by the legal system's inability to determine the true purpose of the payment. A real solution to this problem would be to make it mandatory for judges, when making decisions on alimony, to submit detailed monthly reports on the use of funds received by public servants. This will ensure the correct distribution of pensions and give contributors peace of mind about the purpose of their contributions. In addition, legal reforms and more effective monitoring mechanisms are needed to ensure transparency and accountability in the administration of alimony to protect the rights of beneficiaries and ensure their well-being [13].

2. Related work

To achieve the proposed objectives, the study used the multi-criteria decision-making method (MDMC). MDMC allows to develop procedures that take very complex real situations and make decisions with simplifications in certain situations. In this way, the original problem reaches a solvable state [1], [2] .

Several MDMCs have been developed to solve problems arising in various areas of life and society. [3]–[9] However, traditional methods often use explicit values to evaluate alternatives. Due to the complexity of the environment and human subjectivity, MDMC problems often involve uncertainty, so the information provided to solve them is often confusing or verbal.

To make the information used clearer, the basic elements of neuroscience theory and the methodology used are first described. The results obtained and the conclusions drawn from the research are then applied and presented.

Decision making typically involves the use of human language or, commonly, linguistic parameters. Arguments simply represent words or concepts used in human language. Therefore, this linguistically variable approach is a suitable way for decision makers to express their evaluation. Basic levels can be expressed using linguistic variables. Linguistic variants can be edited in SVNS, as shown in Table 1.

Table 1: Parameters and Single-Digit Neural Networks [SVNN]. Source: [13]

Definition	SVNS
Extremely preferred [ExP]	[1,O ,O]
Very Very Preferred [VVP]	[O.9, O.1, O.1]
Highly preferred [VP]	[0,8,0 ,15,0,20]
Preferred [P]	[0.70,0.25,0.30]
Equally preferred [EP]	[0.50,0.50,0.50]
Not preferred [NP]	[0.35, 0.75 , 0.80]
Very little preferred [VNP]	[0.20,0.85,0.80]
Very little preferred [VVNP]	[0,10,0,90,0,90]
Extremely Not Preferred [ENP]	[O,1,1]

A set of options $G = [G1, G2, \dots, Gn]$ and $A = [A1, \dots, Am]$ a collection of properties. Let be $W = [w1, w2, \dots, wn]$the weight of the attribute where $0 \leq wj \leq 1$ y $\sum_{j=1}^{n} w_j = 1$. Let aij with i = 1, 2...m and j = 1, 2,... , n be the value of the selection attribute Ai associated with the attribute Gj. Then A = [aij] m×n =

$\langle(T_{ij}, I_{ij}, F_{ij})\rangle_{mxn}$ the SVNN matrix. Here, Tij, Iij and Fij are the membership degree, the degree of uncertainty in membership and the degree of uncertainty, respectively. The diagnosis procedure is as follows [15, 16]:

The first step is to find a decision option to evaluate. In the second step, the weights of the decision makers are determined. The logic of the method allows each decision maker to receive unique and different ratings from the other decision makers. This is because each rating is given based on each expert's level of knowledge about the decision issue under discussion. The relative weight of each determinant is considered a language variable and an input to the SVNN, which is then defined by Equation 1. In the third step, the language scores provided by the experts are converted to the SVNN. From the clear and precise individual matrices obtained according to the expert judgment, the individual neutrosophic decision-making matrix is constructed, as shown in Table 1. The initial relationship matrix is obtained for options A = [A1 ,... , Am] and features G = [G1 , G2 ,..., Gn], where each aij , i = 1, 2 ... m , j = 1, 2,.., n are the values of selection attribute Ai with attribute G. A = [aij] m × n = 〈 [Tij,Iij,Fij] 〉 _ mxn is the SVNN matrix, where Tij , Iij , and Fi are the orders of. Equation [2] is used to calculate the member score, the undetected member score, and the non-member score. In the fifth step, the information about the solution is combined. This means that we normalize A = [aij] m × n to B = [bij] m × n . If the decision is a cost factor, the decision information must be shifted to an additional set using equation [17, 18], but if the decision is an efficiency factor, it cannot be shifted.

To give more context to the topic, the decision-making process is crucial in all areas, from personal life to business and academic environments. In academic settings, students are faced with decisions ranging from course selection to choosing research topics. Adopting systematic approaches, such as the method described, can help students make informed and balanced decisions, taking into account various factors and expert opinions.

Furthermore, the use of matrices and equations provides a quantitative framework for evaluating options, which can be especially useful in situations where decisions are influenced by multiple variables. However, it is important to note that while methods can provide structure and clarity, it is also critical to consider the specific context and individual needs when making decisions. Therefore, the application of these methods must be complemented by careful analysis and a deep understanding of the problem at hand. Step 6: Use [5] to build the preference function $P_j[B_i, B_r]$ to replace Bi by Br with feature G j [19] .

$$P_j(B_i, B_r) = \begin{cases} 0 \,, d \le p \\ \frac{d-p}{q-p} \,, p < d < q \\ 1 \,, d \ge q \end{cases} \qquad [1]$$

Step 7 : Calculate the relative weight of attribute w jr , which is the relative weight of G_r with respect to G_j . here

$$w_{jr} = \frac{w_j}{w_r} = [j, r = 1,2, \dots, n] \qquad [2]$$

Step 8: Determine priority power π [B_{yo}, Br] of circuit Bi with respect to Br using the following formula:

$$[1] \quad \pi(B_i, B_r) = \frac{\sum_{j=1}^{n} w_{jr} P_j(B_i, B_r)}{\sum_{j=1}^{n} w_{jr}} \qquad [3]$$

Step 9: Calculate the input $\Phi^+[B_i]$, the output $\Phi^-[B_i]$ and the net input $\Phi[B_i]$ as follows:

$$\Phi^+(B_i) = \frac{\sum_{r=1}^{m} \pi(B_i,B_r) - \min\limits_{1\le i\le m} \{\sum_{r=1}^{m} \pi(B_i,B_r)\}}{\max\limits_{1\le i\le m} \{\sum_{r=1}^{m} \pi(B_i,B_r)\} - \min\limits_{1\le i\le m} \{\sum_{r=1}^{m} \pi(B_i,B_r)\}} \qquad [4]$$

$$\Phi^-(B_i) = \frac{\sum_{r=1}^{m} \pi(B_r,B_i) - \min\limits_{1\le i\le m} \{\sum_{r=1}^{m} \pi(B_r,B_i)\}}{\max\limits_{1\le i\le m} \{\sum_{r=1}^{m} \pi(B_r,B_i)\} - \min\limits_{1\le i\le m} \{\sum_{r=1}^{m} \pi(B_r,B_i)\}} \qquad [5]$$

$$\Phi(B_i) = \Phi^+(B_i) - \Phi^-(B_i) \qquad [6]$$

Step 1O: Sort all options by value $\Phi(B_i)$. The higher the value, $\Phi(B_i)$, the better the option.

Systematic process

To find alternatives to evaluate, we analyze child support payments, trying to identify and understand fundamental violations of the rights of the beneficiaries.

1. **Obligation to Pay [VIOL1]** : One of the most common violations is that a person who owes child support payments fails to meet their financial obligations in a regular and timely manner. This can be due to a variety of reasons, including unemployment, lack of reported income, or simply refusing to comply with court orders.
2. **Unilateral Change of Agreement [VIOL2]** – In some cases, the obligor may attempt to unilaterally change the terms of a child support agreement without the consent of the payee or due process of law. This may include attempts to cut alimony or suspend benefits without court permission.
3. **Lack of Access to Financial Information [VIOL3]** : Recipients have the right to complete and up-to-date information about the income and assets of the person obligated to pay child support to ensure that the proper amount is paid. Lack of financial transparency on the part of the debtor can make it difficult to determine a fair amount of support.
4. **Deprivation of visitation or access to children [VIOL4]** : When child support includes custody of a child, unreasonable deprivation of visitation or access to a child may be considered a violation of the rights of the recipient's child.
5. **Failure to Comply with a Court Order [VIOL5]** – This includes any action that directly violates a court order related to child support, such as failure to comply with a mediation agreement, failure to comply with a court-ordered payment plan, or failure to comply with a court-ordered filing of documents. Financial statements required by the court.

The other evaluation criteria provide guidance for use in the decision-making process and serve as a source of principles for evaluating controls. In this way, alternatives to a problem can be analyzed from the same perspective. This study was designed using four evaluation criteria, which were presented to decision-makers and validated. During the analysis, the experts agreed to give each criterion the same weight in terms of importance [each weight value w = 0.25].

For the purposes of this survey the following criteria will be used:

1. **Receipt of Child Support** : Assessing whether the recipient has active access to child support, including receiving agreed-upon payments on a regular and timely basis.
2. **Reasonable Amount Obligation** – Determines whether the amount of child support is sufficient and reasonable to meet the needs of the recipient and any dependent children [if applicable].
3. **Right to financial information** – Make sure the recipient has the right to maintain up-to-date information about the income and assets of the person who owes child support to ensure the proper amount is paid.
4. **Custody and Visitation** : Assesses whether the recipient's custody and visitation rights are being respected under the child support agreement.

Conclusion

Table 2 shows the scores given to the decisions based on their relative importance to the issue under consideration.

Table 2: Classification assigned to decision makers according to their importance. Source: Home.

Deciders	Linguistic assessment	SVNN	Numeric value
Decider 1	very important	[0.9;0. 1;0.1]	0.23
Decider 2	Moderately important	[0.5;0. 5;0.5]	0.15

Deciders	Linguistic assessment	SVNN	Numeric value
Decider 3	very important	[0.9;0. 1;0.1]	0.22
Decider 4	very important	[0.9;0. 1;0.1]	0.20
Decider 5	Important	[0.75;0. 25;0.20]	0.2

The decision maker evaluates the specific alternatives individually based on each criterion or attribute selected for evaluation using Equation [2], which is then transformed to obtain an overall decision matrix of the alternatives shown in Table 3.

Table 3: *Reference for option decisions* . Source: Own elaboration

	Accessibility	**Job stability**	**Equal opportunities**	**Reasonable adjustments**
VIOL1	[0.61434; 0.38576 ; 0.35486]	[0.67439; 0.33571 ; 0.38374]	[0.7636; 0.3374 ; 0.3081]	[0.7357; 0. 3743; 0.3519]
VIOL2	[0.55653; 0. 44347; 0.43667]	[0.5;0. 5;0.5]	[0.56731;0. 43369;0.41301]	[0.5;0. 5;0.5]
VIOL3	[0.68696;0. 31304;0.3988]	[0.54397;0. 47088;0.45555]	[0.47187; 0. 54413; 0.5515]	[0.6034;0. 4096;0.3789]
VIOL4	[0.69071;0. 30939;0.39533]	[0.61633; 0.38377 ; 0.35344]	[0.47187; 0.54413 ; 0.5515]	[0.5673; 0.4337 ; 0.413]
VIOL5	[0.5; 0. 5; 0.5]	[0.55653; 0.44347 ; 0.43667]	[0.5; 0. 5; 0.5]	[0.7445; 0.3555 ; 0.3555]

This calculation can be performed using the linear function proposed in [4]. For this case it is assumed that q = 1, p = 0, obtaining the matrices from P_1 to P_4.

$$P_1 = \begin{array}{c|ccccc} & B_1 & B_2 & B_3 & B_4 & B_5 \\ B_1 & 0.0000 & 0.0000 & 0.0187 & 0.0199 & 0.0000 \\ B_2 & 0.0339 & 0.0000 & 0.0436 & 0.0438 & 0.0000 \\ B_3 & 0.0000 & 0.0000 & 0.0000 & 0.0013 & 0.0000 \\ B_4 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ B_5 & 0.0484 & 0.0345 & 0.0671 & 0.0683 & 0.0000 \end{array}$$

$$P_2 = \begin{array}{c|ccccc} & B_1 & B_2 & B_3 & B_4 & B_5 \\ B_1 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ B_3 & 0.0731 & 0.0000 & 0.0103 & 0.0493 & 0.0344 \\ B_2 & 0.0619 & 0.0000 & 0.0000 & 0.0390 & 0.0143 \\ B_4 & 0.0339 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ B_5 & 0.0476 & 0.0000 & 0.0000 & 0.0347 & 0.0000 \end{array}$$

$$P_3 = \begin{array}{c|ccccc} & B_1 & B_2 & B_3 & B_4 & B_5 \\ B_1 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ B_2 & 0.0683 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ B_3 & 0.1198 & 0.0515 & 0.0000 & 0.0000 & 0.0225 \\ B_4 & 0.1198 & 0.0515 & 0.0000 & 0.0000 & 0.0225 \\ B_5 & 0.0973 & 0.0290 & 0.0000 & 0.0000 & 0.0000 \end{array}$$

$$P_4 = \begin{array}{c|ccccc} & B_1 & B_2 & B_3 & B_4 & B_5 \\ B_1 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ B_2 & 0.0827 & 0.0000 & 0.0364 & 0.0290 & 0.0815 \\ B_3 & 0.0463 & 0.0000 & 0.0000 & 0.0000 & 0.0451 \\ B_4 & 0.0537 & 0.0000 & 0.0074 & 0.0000 & 0.0525 \\ B_5 & 0.0012 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \end{array}$$

Using Equation [6] the general preference index is obtained as shown in the matrix and Πfrom there the inputs, outputs and net flow for each option are obtained as shown in Table 4.

$$\Pi = \begin{vmatrix} & B_1 & B_2 & B_3 & B_4 & B_5 \\ B_1 & 0.000 & 0.000 & 0.005 & 0.005 & 0.000 \\ B_2 & 0.062 & 0.000 & 0.022 & 0.030 & 0.026 \\ B_3 & 0.057 & 0.013 & 0.000 & 0.010 & 0.020 \\ B_4 & 0.049 & 0.013 & 0.002 & 0.000 & 0.019 \\ B_5 & 0.049 & 0.013 & 0.017 & 0.023 & 0.000 \end{vmatrix}$$

Table 4: *Inputs, outputs and net substitute flows . Note:* Source: Personal information.

VIOL1	Oh	1,000	- 1,000
VIOL2	1	O.OOO	1,000
VIOL3	O.691	OO36	O.654
VIOL4	O.555	O.167	O.388
VIOL5	O.7O3	O.15O	O.553

In this analysis, positive and negative trends represent levels of strength and lightness relative to other options. Unilateral contract modifications, where a promisor can attempt to change the terms of a child support agreement without the recipient's consent or due process, carry more risk and harm than other standards... This leads to a lack of access to financial information, lower preferences than others, and defaults.

When analysing the negative flow, it is observed that non-payment is the crime with the greatest disadvantage compared to others. In this case, all regulations demonstrate the same level of risk aversion. These findings highlight the importance of prioritising unilateral contractual changes and payment issues, as well as the need to improve access to financial information to ensure transparency and accountability in the administration of child support. It is important to implement measures to protect the rights of beneficiaries and ensure that the funds provided to support them are used appropriately.

3 Conclusion

In summary, the legal reviews by many authors highlight the importance of establishing systems for monitoring maintenance administrators and ensuring transparency in the management of these resources. Experts agree that this approach not only protects the interests of the alimony recipient, but also promotes a balanced relationship between the parties by protecting the rights and peace of mind of the payer. The importance of the design and methods used in this study is reflected in the collective responses of lawyers who support the implementation of a monitoring system. This bill provides a possible solution to the problem by ensuring adequate control over the use of funds allocated for the maintenance and well-being of alimony recipients. The validity of the reform proposals was underlined by the support of commentators and lawyers. Through surveys and interviews, a consensus was reached on the need to establish a control system for cost administrators. This program will not only strengthen the rights of beneficiaries, but will also provide security and transparency to payers about the purpose of the funds provided. Ultimately, the implementation of this system will help improve the effectiveness of the judicial system and ensure greater well-being for all parties involved in the collection of child support.

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